P-3.1 Apply energy formulas to determine potential and kinetic energy and explain the transformation from one to the other

Revised Taxonomy Levels **3.2 C_A Apply (implement) procedural knowledge**
2.7 B Explain conceptual knowledge

Key Concepts
Potential energy
Kinetic energy
Mechanical energy
Conservation of energy
In physical science students "explain the factors that determine potential and kinetic energy and the transformation of one to the other" (PS-6.). They do not address the formulas for potential and kinetic energy or the mathematical aspect of the transformation, one to the other.

It is essential for students to
- Analyze potential energy (energy of position) and kinetic energy (energy of motion) using energy formulas
- Understand that the gravitational potential energy of an object is equal to the object's weight (mass x acceleration of gravity) multiplied by the vertical distance through which the object is lifted. ($E_p = ma_gh$) = (N)(m)
- Understand that the kinetic energy of a moving object is equal to the object's mass times its velocity-squared, divided by two. ($E_k = ½ mv^2$) = Nm
- Understand that the unit used to measure energy is the joule (Nm)
- Understand that the potential energy of an object can be converted to kinetic energy or the kinetic energy to potential energy.
- Solve problems involving transformations between potential and kinetic energy.

Assessment
The verb implement (apply) means that a major focus of assessment should be for students to show that they can "apply a procedure to an unfamiliar task". The knowledge dimension of the indicator, procedural knowledge means "knowledge of subject-specific techniques and methods" In this case the procedure is application of the concept of the conservation of energy during transformations between kinetic and potential energy. The unfamiliar task should be a novel word problem or laboratory investigation. A key part of the assessment will be for students to show that they can apply the knowledge to a new situation, not just repeat problems which are familiar. This requires that students have a conceptual understanding of each of energy conservation as well as mastery of the skills required to implement the mathematical equations or in order to solve problems.

The verb explain means that another focus of assessment should be for students to "construct a cause and effect model". In this case, assessments will ensure that students can model how the energy is conserved during kinetic-potential transformations.
Because the indicator is written as conceptual knowledge, assessments should require that students understand the "interrelationships among the basic elements within a larger structure that enable them to function together." In this case, assessments must show that students can construct a cause and effect statement relating how a change in one type of energy affects the other type of energy.